IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Andrew Michael Duggan

Serial No.: 10/601,405

Confirmation No.: Unassigned

Filed: June 23, 2003

For: BORE-LINING TUBING

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Group Art Unit: Unassigned

Examiner: Unknown

Customer No.: 36,735

CERTIFICATE OF MAILING
37 CFR 1.8
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22 Sept 03
Date

William B Patterson
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Commissioner for Patents
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Alexandria, VA 22313-1450

Dear Sir:

CLAIM TO PRIORITY

Applicant reaffirms the claim for the benefit of the filing date of the following foreign patent application referred to in Applicant's Declaration:

British Patent Application No. 0215107.4 filed June 29, 2002.

A copy of the application certified by the British Patent Office is enclosed.

Respectfully submitted,

Date: 22 Sept 2003

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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

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THE PATENT OFFICE
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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — AS/RO/HSo/P11958GB

2. Patent application number *(The Patent Office will fill in this part)* — 0215107.4 — 29 JUN 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

WEATHERFORD/LAMB, INC.
515 POST OAK BLVD
SUITE 600
HOUSTON, TEXAS 77027
UNITED STATES OF AMERICA

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — DELAWARE, U.S.A. — 8028714001

4. Title of the invention

BORE-LINING TUBING

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

CRUIKSHANK & FAIRWEATHER
19 ROYAL EXCHANGE SQUARE
GLASGOW
G1 3AE
UNITED KINGDOM

Patents ADP number *(if you know it)* — 547002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
-	-	-

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*
-	

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

BORE-LINING TUBING

FIELD OF THE INVENTION

This invention relates to bore-lining tubing and to a method of lining a drilled bore.

BACKGROUND OF THE INVENTION

Expandable downhole tubulars are being used increasingly in the oil and gas exploration and production industry.

It is amongst the objects of embodiments of the present invention to provide downhole tubing which facilitates the hanging and cementing of an expandable liner.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a method of lining a drilled bore, the method comprising the steps of:

providing a first tubular having a profiled portion describing an internal diameter;

locating the first tubular in a bore;

providing an expandable, second tubular having an external diameter less than the internal diameter of the first tubular;

locating the second tubular in the bore with an upper end of the second tubular overlapping the profiled portion of the first tubular;

expanding an upper end portion of the second tubular

portion of the second tubular located above said profiled lower end portion into sealing contact with a wall of the first tubular. Accordingly, the second tubular may be located in the bore such that it overlaps the profiled lower end portion and extends partly into an unprofiled portion of the first tubular. Alternatively, the second tubular may be sealed to the first tubular by expanding part of the upper end portion of the second tubular located below said profiled lower end portion into sealing contact with a wall of the first tubular. Accordingly, the first tubular may include an unprofiled part below the profiled lower end portion against which the second tubular may be sealed.

The upper end portion of the second tubular may be expanded to an internal diameter substantially equal to the internal diameter of the first tubular. This allows full bore access without any restriction in the bore caused by the coupling. This may be achieved by providing a first tubular having a profiled lower end portion of an internal diameter greater than the internal diameter of a remainder of the first tubular, to accommodate expansion of the second tubular.

In an alternative, the second tubular may be sealed to the first tubular by deforming one or both of the first and second tubulars. In one embodiment, the second tubular may be sealed to the first tubular by deforming the profiled

The provision of bore-lining tubing including a flow passage allows the tubing to be set in the bore and cemented after expansion of the second tubular.

Preferably, the first tubular profiled portion comprises a profiled lower end portion. Alternatively, the profiled portion may be provided at any desired location along a length of the first tubular.

The second tubular may be expanded at a level below the coupling. Preferably, the second tubular is expanded to an internal diameter substantially equal to an internal diameter of the first tubular. Preferably also, the expandable, second tubular comprises an expandable solid tubular.

An inner wall of the profiled lower end portion of the first tubular may include at least one flute, groove, channel or cutout defining said flow passage. Preferably, the profiled lower end portion includes a plurality of flutes, grooves, channels or cutouts around the internal circumference of the tubular, each defining a separate flow passage between the first and second tubulars. The (or each) flute, groove, channel or cutout may extend substantially axially or helically around the inner wall of the profiled lower end portion.

The internal diameter of the profiled lower end portion of the first tubular may be less than an internal diameter of the remainder of the first tubular.

According to a fourth aspect of the present invention, there is provided bore-lining tubing comprising a tubular having a profiled portion defining at least one flow passage extending along the profiled portion.

BRIEF DESCRIPTION OF DRAWINGS

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1A is a schematic cross-sectional view of a bore lined with bore-lining tubing in accordance with a first embodiment of the present invention, showing a first tubular in the bore and a second expandable tubular located within the first tubular;

Fig. 1B is a cross-sectional view of the bore-lining tubing taken in the direction of line A-A of Fig. 1A;

Fig. 2A is a view of the bore-lining tubing of Fig. 1A, showing the second tubular partially expanded into contact with the first tubular;

Fig. 2B is a cross-sectional view of the bore-lining tubing taken in the direction of line B-B of Fig. 2A;

Fig. 3 is a view of the bore-lining tubing of Fig. 1A, showing a lower part of the second tubular fully expanded;

Fig 4 is a view of the bore-lining tubing of Fig. 1A, showing the second tubular fully expanded;

Fig. 5 is a view of a bore-lining tubing in accordance with an alternative embodiment of the present invention;

and/or drilling followed by underreaming the bore 10 to a determined internal diameter.

The bore-lining tubing 12 also includes an expandable, second tubular in the form of an expandable liner 22. The liner 22 is run-in from surface and located such than an upper end portion 24 of the liner 22 overlaps the profiled lower end portion 20 of the lower casing section 17.

Fig. 1B is a cross-sectional view of the bore-lining tubing 12 taken on line A-A of Fig. 1A. The profiled lower end 20 of the lower casing section 17 includes a number of axial flutes, spaces or other means defining a by-pass 26 between thickened wall portions 28. In the tubing configuration of Figs. 1A and 1B, there is an annular clearance 30 between the liner 22 and the thickened portions 28.

An expansion device is then activated, to expand an area 32 of the liner upper end portion 24 into contact with the thickened portions 28, as shown in the view of Fig. 2A, and the cross-sectional view of Fig. 2B, taken on line B-B of Fig. 2A. This provides a secure coupling 29 between the liner 22 and the casing 16, from which the liner 22 may then be suspended. Significantly, the flutes/spaces 26 in the profiled lower end of the casing 16 are kept open and define one or more flow passages between the profiled lower end 20 and the liner 22. This allows fluid flow between the first and second tubulars 16 and 22, from the bore 10,

in the passages. The bore 10 has then been fully lined and sealed to a desired depth.

Fig. 5 shows an alternative embodiment of the present invention, with bore-lining tubing indicated generally by reference numeral 112 located in a bore 100. Like components of the bore-lining tubing 112 with the tubing 12 of Figs. 1-4 share the same reference numerals incremented by 100.

The bore-lining tubing 112 and the method for expanding and cementing the tubing is substantially the same as that described with reference to Figs. 1-4. However, the bore-lining tubing 112 differs in that the lower end of the borehole casing 116 includes a different profiled lower end portion 120. As shown in Fig. 5, the internal diameter between the thickened portions 128 of the lower end portion 120 is greater than the internal diameter of the remainder of the casing 16. In this fashion, when the area 132 of the liner 122 is expanded into contact with the profiled lower end portion 120 (in a procedure corresponding to that shown in Fig. 2A), the joint between the tubulars does not restrict the bore and the expanded liner 122 has an internal diameter equal to that of the casing 16. This allows full bore access after completion of the procedure.

Fig. 6A shows a further alternative embodiment of the present invention, illustrating part of a bore lining

portion 36 that defines an upset on the casing.

Flow passages 326 are spaced circumferentially around the upset 36, and extend axially through the upset 36. A liner 322 is located in the casing 316, with an area 332 expanded into contact with the casing 316 to create a hanging support. In this position, the flow passages 326 remain open to allow fluid circulation for subsequent cementation. The flow passages 326 are then isolated by expanding the liner 322 above the coupling 329, as described above.

Fig. 8 shows a still further alternative embodiment of the present invention, illustrating part of a bore lining tubing indicated generally by reference numeral 412. Like components of the bore lining tubing 412 with the tubing 12 of Figs. 1-4 share the same reference numerals incremented by 400. In the figure, only the borehole casing 416 is shown, for ease of reference. However, a liner such as the liners 22, 122 or 322, described above with reference to Figs. 1 to 7, is typically coupled to the casing.

The borehole casing 416 is substantially similar to the casings 16, 116, 216 described above, except that the profiled lower end portion 420 comprises relatively thick-walled portions 428 defining axial flutes or the like, similar to the casing 16. However, the thick-walled portions 428 are located above a lowermost end 38 of the lower casing section 417 shown in the figure. In a further

circulated through the liner 522 into the annulus 534. The flow passages are then closed by further expanding the upper end 524 of the liner 522 into contact with the inner wall of the larger diameter portion 38.

It will be appreciated that the drawings of Figs. 1A to 9 are schematic illustrations where some dimensions have been exaggerated for ease of reference.

Various modifications may be made to the foregoing within the scope of the present invention. For example, the profiled portion of the first tubular may be of any desired shape and may include, for example, at least one, typically a plurality of helical flutes, or axial or helical grooves, channels, cut-outs or the like. There may be any desired number of flow passages. The profiled lower end portion may be corrugated or otherwise shaped and may be deformable. Accordingly, when the second tubular is deformed into contact with the first tubular, the first and second tubulars may be deformable together to expand the coupling out to the same internal diameter as the remainder of the first tubular, to allow full bore access.

Instead of expanding the liner out below the coupling between the tubulars, the liner may be maintained at an unexpanded diameter.

The flow passages may be closed by any desired means, for example, the second tubular may be deformed into sealing contact with the first tubular below the coupling,

WE CLAIM:

1. A method of lining a drilled bore, the method comprising the steps of:

providing a first tubular having a profiled portion describing an internal diameter;

locating the first tubular in a bore;

providing an expandable, second tubular having an external diameter less than the internal diameter of the first tubular;

locating the second tubular in the bore with an upper end of the second tubular overlapping the profiled portion of the first tubular;

expanding an upper end portion of the second tubular into contact with the profiled portion of the first tubular, to create a coupling including a flow passage between the first tubular and the second tubular;

flowing fluid via said flow passage; and then

sealing the second tubular to the first tubular.

2. A method as claimed in claim 1, further comprising providing a first tubular having a profiled lower end portion.

3. A method as claimed in claim 1 or 2, wherein the coupling between the upper end portion of the second

9. A method as claimed in claim 7, further comprising sealing the second tubular to the first tubular by expanding part of the upper end portion of the second tubular located below said profiled portion into sealing contact with a wall of the first tubular.

10. A method as claimed in claim 7, further comprising sealing the second tubular to the first tubular by deforming both the first and second tubulars.

11. A method as claimed in claim 10, further comprising deforming the profiled portion of the first tubular by expansion of the upper end portion of the second tubular into contact with the first tubular.

12. A method as claimed in any preceding claim, further comprising expanding the upper end portion of the second tubular to an internal diameter substantially equal to the internal diameter of the first tubular.

13. A method as claimed in claim 12, further comprising providing a first tubular having a profiled portion of an internal diameter greater than the internal diameter of a remainder of the first tubular, to accommodate expansion of the second tubular.

25. Bore-lining tubing as claimed in any one of claims 21 to 24, wherein the inner wall of the profiled portion defines an open-sided channel.

26. Bore-lining tubing as claimed in any one of claims 21 to 24, wherein the channel comprises a closed-sided channel.

27. Bore-lining tubing as claimed in any one of claims 16 to 26, wherein the internal diameter of the profiled portion of the first tubular is less than an internal diameter of the remainder of the first tubular.

28. Bore-lining tubing as claimed in any one of claims 16 to 26, wherein the internal diameter of the profiled portion of the first tubular is greater than an internal diameter of the remainder of the first tubular.

29. Bore-lining tubing as claimed in claim 28, wherein the profiled portion of the first tubular is of an external diameter greater than an external diameter of the remainder of the first tubular.

30. Bore-lining tubing as claimed in any one of claims 16 to 29, wherein the profiled portion of the first tubular is profiled internally and externally and is deformable to

36. Bore-lining tubing as claimed in any one of claims 32 to 35, wherein the internal diameter of the profiled portion of the first tubular is less than an internal diameter of the remainder of the first tubular.

37. Bore-lining tubing as claimed in any one of claims 32 to 36, wherein the internal diameter of the profiled portion of the first tubular is greater than an internal diameter of the remainder of the first tubular.

38. Bore-lining tubing as claimed in claim 37, wherein the profiled portion of the first tubular is of an external diameter greater than an external diameter of the remainder of the first tubular.

39. Bore-lining tubing as claimed in any one of claims 32 to 38, wherein the profiled portion of the first tubular is profiled internally and externally and is deformable to allow said flow passage to be closed by expansion of the second tubular.

40. Bore-lining tubing as claimed in claim 39, wherein the profiled portion of the first tubular is corrugated.

41. Bore-lining tubing comprising a tubular having a profiled portion defining at least one flow passage

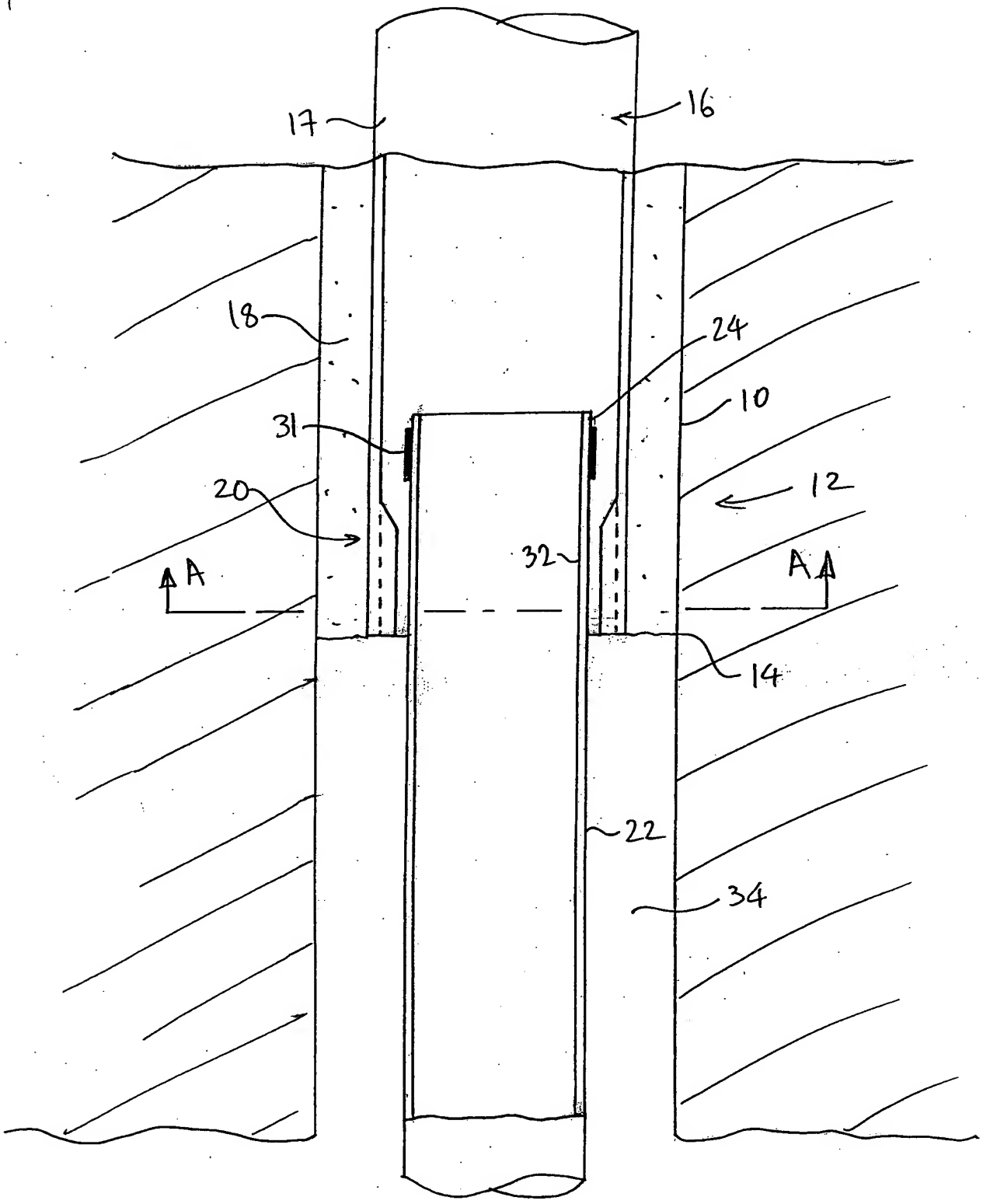

FIG1A

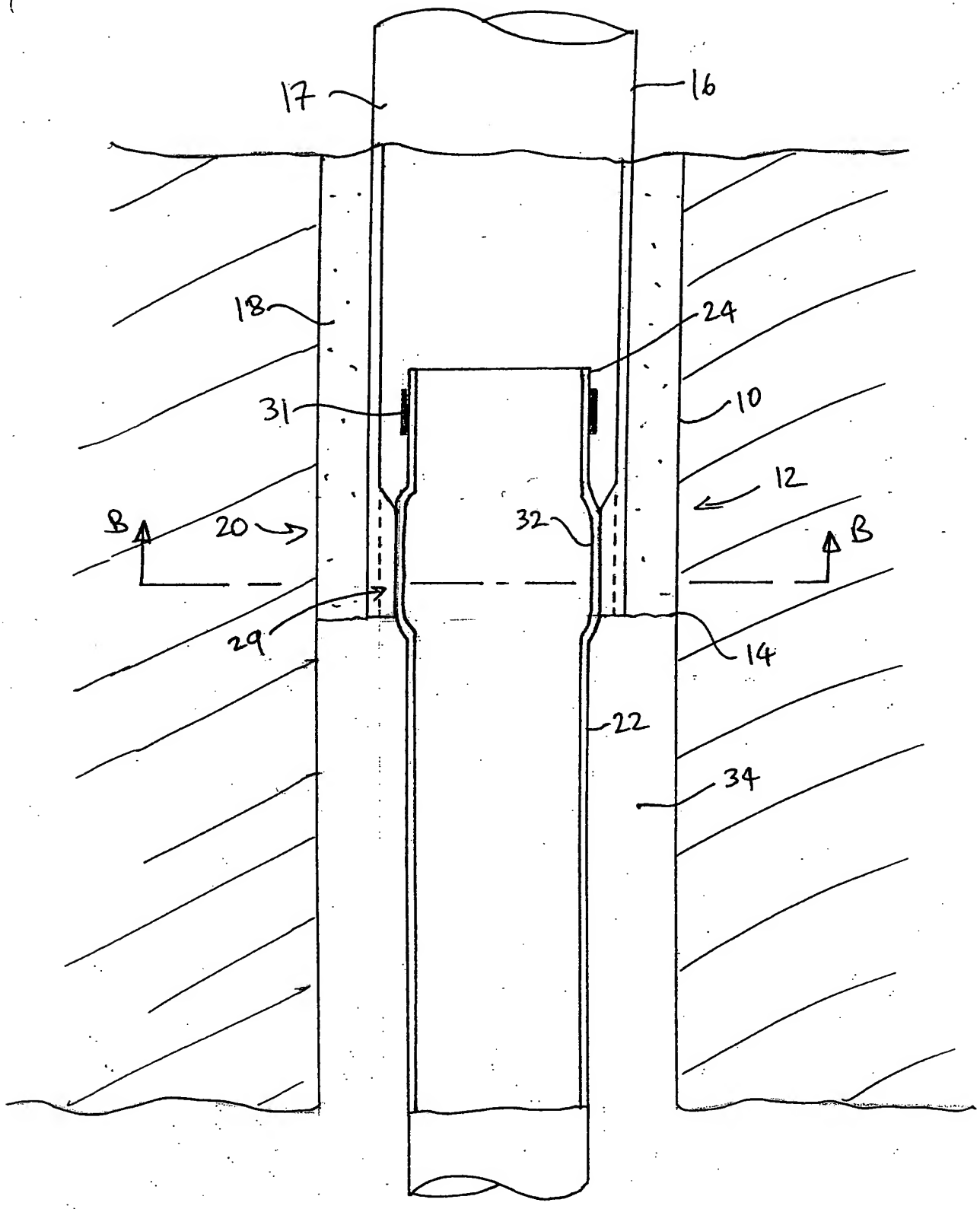

FIG2A

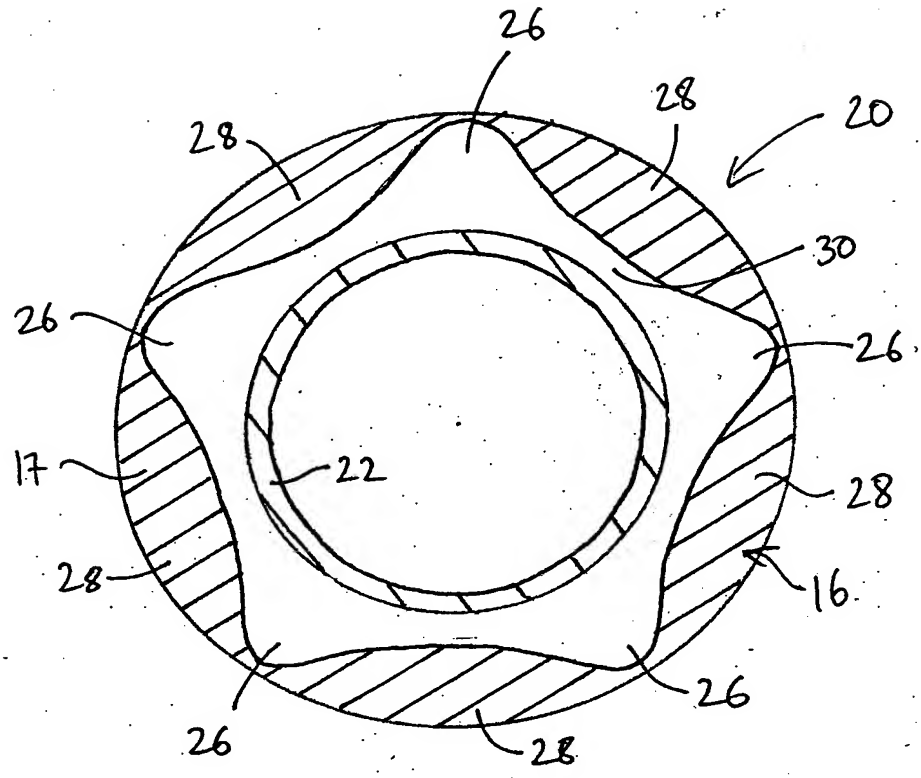
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FIG 1B

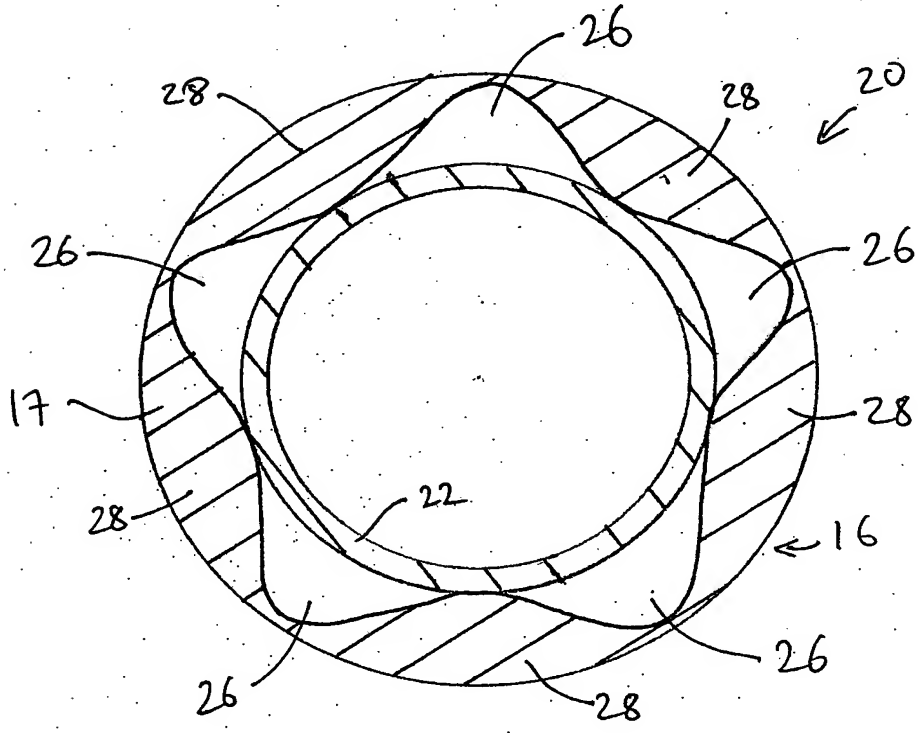
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FIG 2B

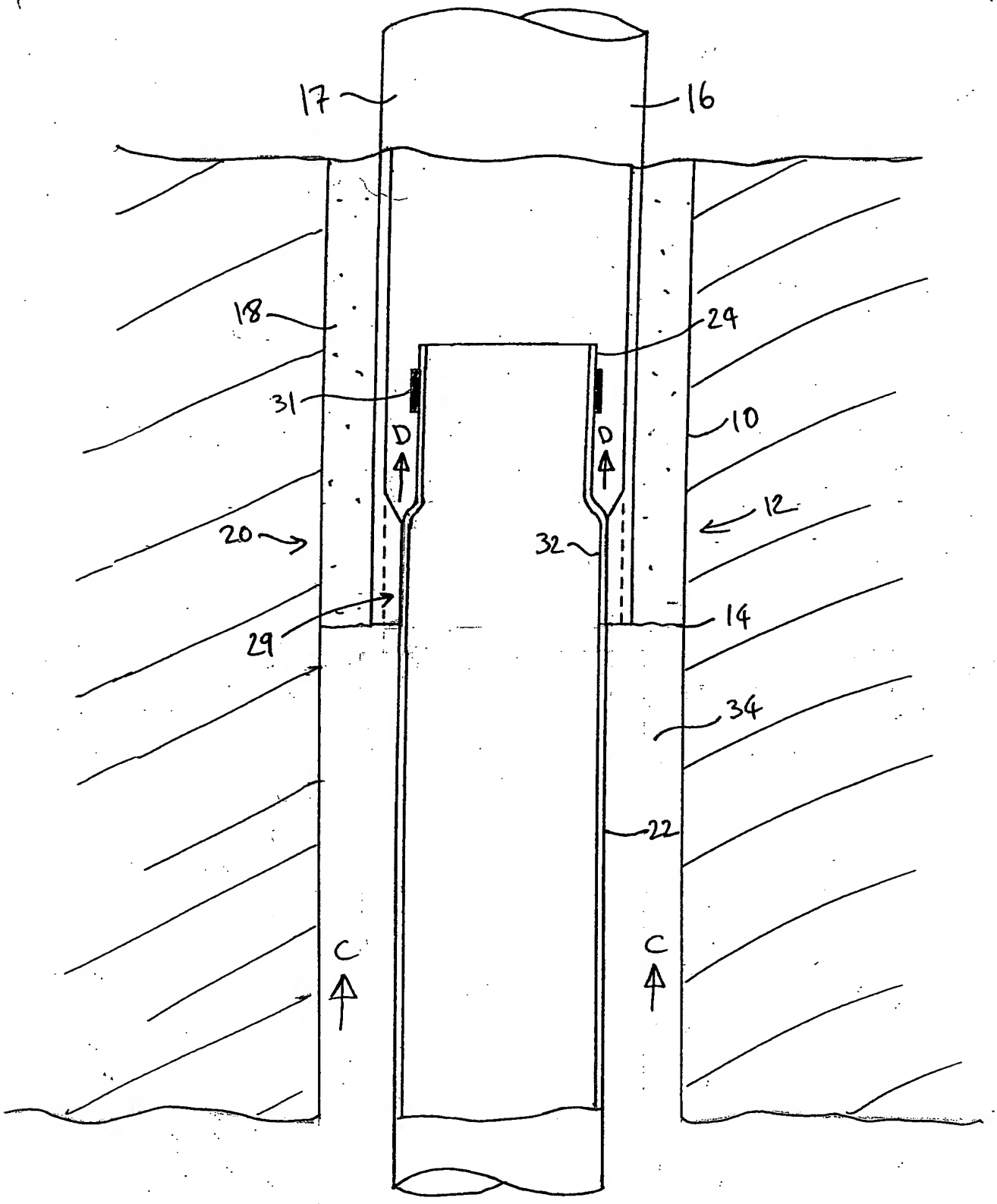

FIG3

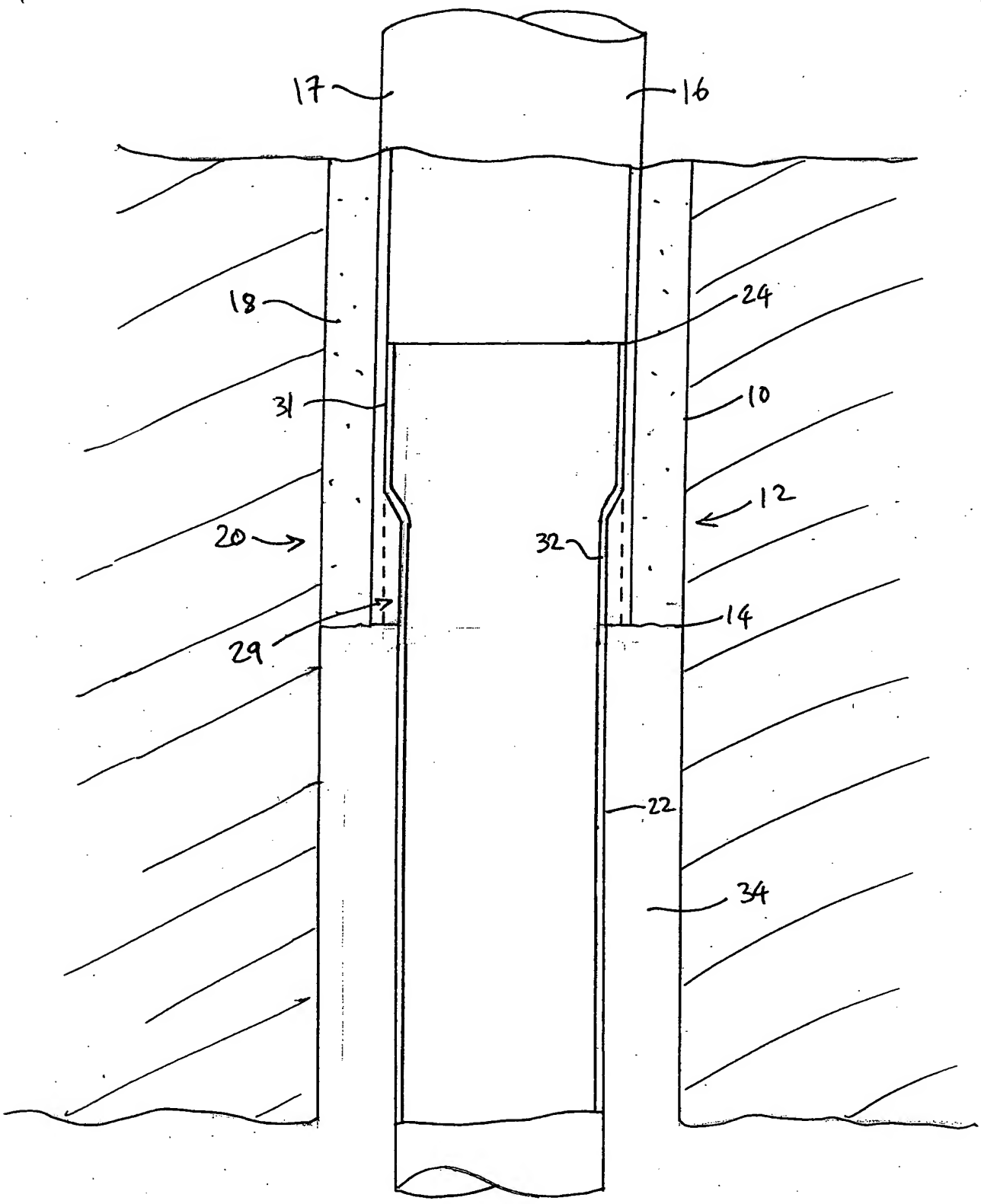

FIG4

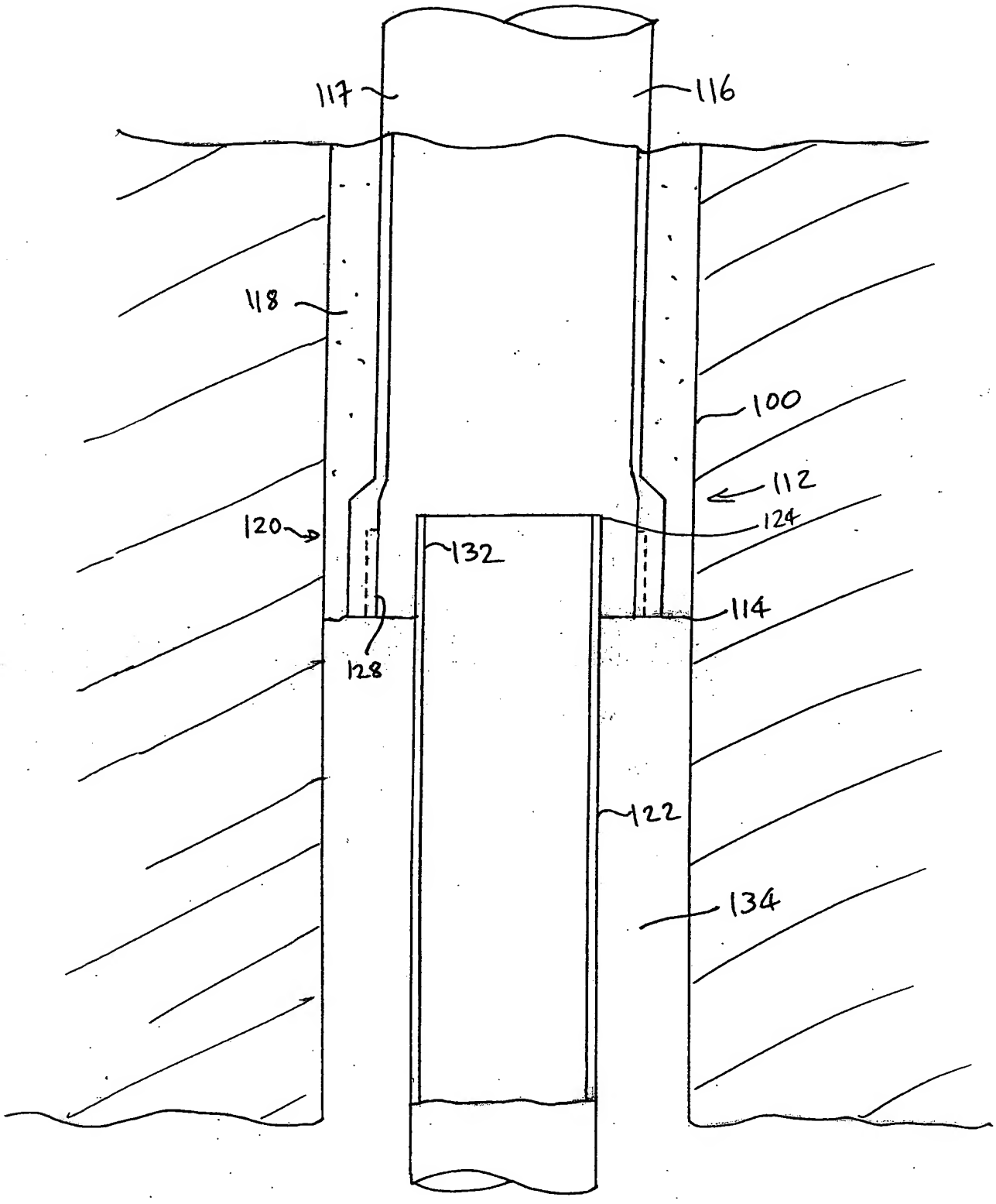

FIG 5

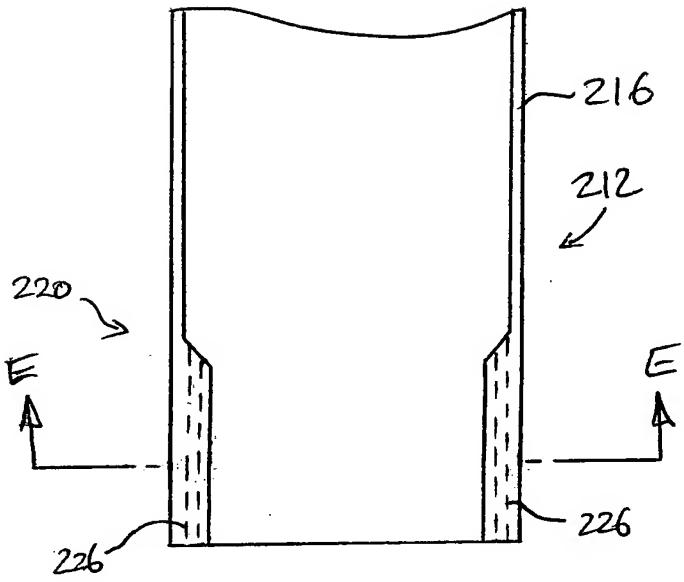

FIG6A

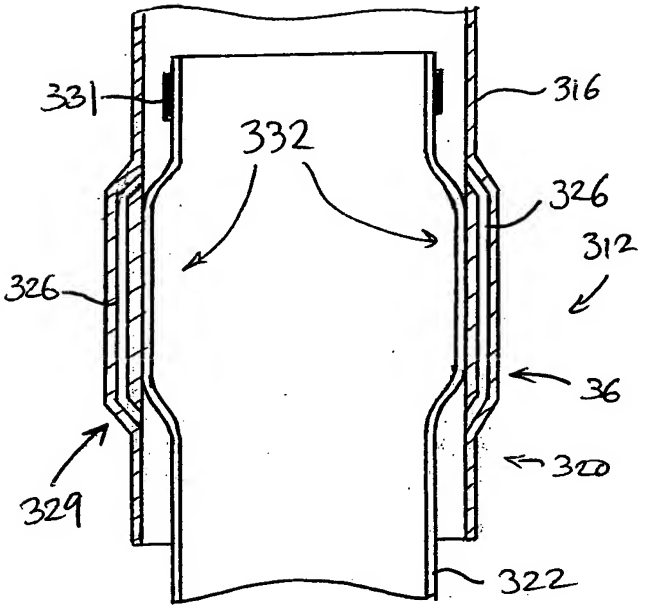

FIG7

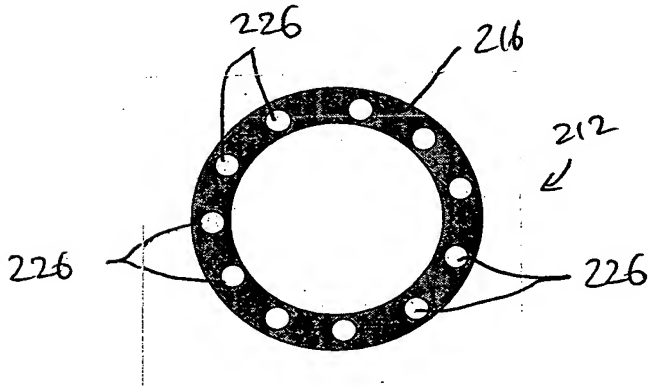

FIG6B

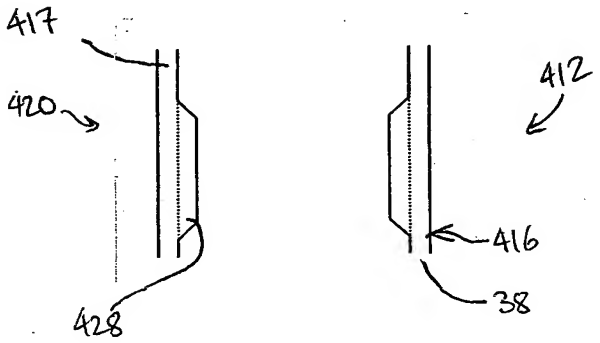

FIG8

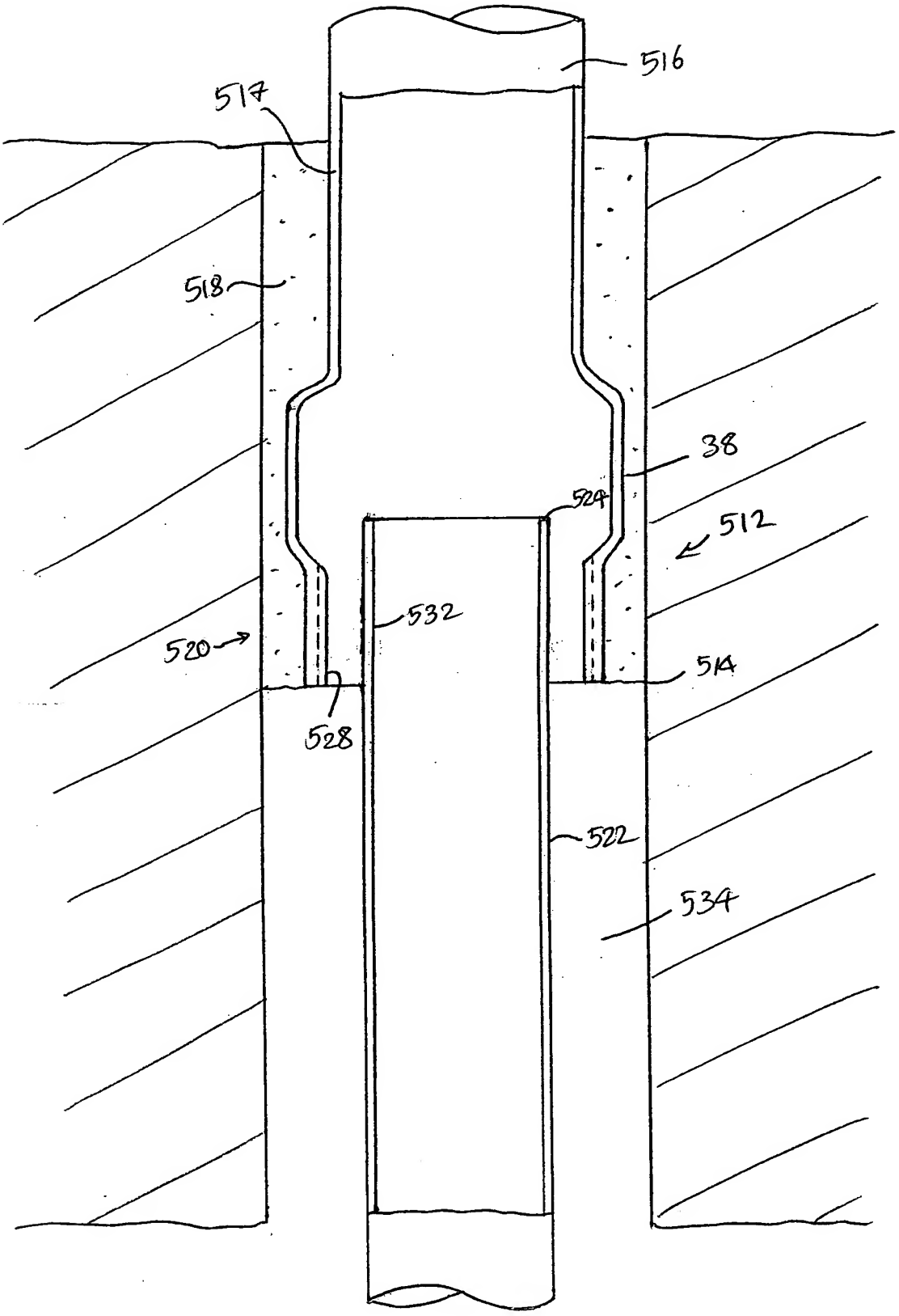

FIG 9